

Scientific Inquiry

6-1 The student will demonstrate an understanding of technological design and scientific inquiry, including the process skills, mathematical thinking, controlled investigative design and analysis, and problem solving.

6-1.4 Use a technological design process to plan and produce a solution to a problem or a product (including identifying a problem, designing a solution or a product, implementing the design, and evaluating the solution or the product).

Taxonomy Level: 3.2-C Apply Procedural Knowledge

Previous/Future knowledge: In 5th grade (5-1.7), students used a simple technological design process to develop a solution or a product, communicating the design by using descriptions, models, and drawings. In high school Physical Science (PS-1.8), students will compare the processes of scientific investigation and technological design.

It is essential for students to know that science is the process of learning about the natural world by asking questions and trying to find the answers to those questions. Scientific knowledge is used to develop and enhance science knowledge. Technology applies scientific knowledge in order to develop a solution to a problem or create a product to help meet human needs. Technology is usually developed because there is a need or a problem that needs to be solved. Steps in the technological design process include:

- *Identifying a problem or need*
 - Research and gather information on what is already known about the problem or need
- *Designing a solution or a product*
 - Generate ideas on possible solutions or products
 - Evaluate the factors that will limit or restrict the solution or product design
 - Determine the trade-offs of the solutions or products (what must be given up in order to create the solution or product)
- *Implementing the design*
 - Build and test the solution or product
 - Identify any problems with the solution or product
 - If necessary, redesign the solution or product to eliminate any problems in the design
- *Evaluating the solution or the product*
 - Determine if the solution or product solved the problem
 - Identify the pros and cons of the solution or product

The steps of the design can be communicated using descriptions, models, and drawings.

- A *scientific model* is an idea that allows us to create explanations of how something may work. Models can be physical or mental.

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It is also essential for students to follow appropriate steps when conducting a controlled scientific investigation. In a *controlled scientific investigation* some or all of the following steps should be included:

- Identify a testable question (tests one variable) that can be investigated
- Research information about the topic
- State the hypothesis as a predicted answer to the question, what may be the possible outcome of the investigation
- Design an experiment to test the hypothesis, controlling all variables except the independent (manipulated) variable
 - Plan for independent (manipulated) and dependent (responding) variables
 - Plan for factors that should be held constant (controlled variables)
 - List the materials needed to conduct the experiment
 - List the procedures to be followed
 - Plan for recording, organizing and analyzing data
- Conduct the experiment and record data (observations) in tables, graphs, or charts
- Analyze the data in the tables, graphs, or charts to figure out what the data means (describe the relationship between the variables)
- Compare the results to the hypothesis and write a conclusion that will support or not support the hypothesis based on the recorded data
- Communicate the results to others

It is not essential for students to compare the processes of a controlled scientific investigation and the technological design process or evaluate a technological design or product on the basis of designated criteria (including cost, time, and materials).

Assessment Guidelines:

The objective of this indicator is to *use* a technological design process to plan and produce a solution to a problem or a product; therefore, the primary focus of assessment should be to apply the procedures for a technological design process using the steps listed in the indicator. However, appropriate assessments should also require students to *classify* by sequencing the steps of a technological design process or a controlled scientific investigation; *explain* how a particular product or process solves a problem; *summarize* the design process of a solution or product; *summarize* the steps in a controlled scientific investigation; *exemplify* technology; or *identify* the solution or product in a technological design process.